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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:
Runkle et al.

Group Art Unit: 1732

Serial No. 09/851,242

Examiner: S. Staicovici

Filed: May 8, 2001

For: METHOD FOR MAKING A HOLLOW FIBER MEMBRANE CONTACTOR

VIA FACSIMILE
571-273-8300
Total Pages: 64

REQUEST FOR REINSTATEMENT OF THE APPEAL AND
AMENDED SUPPLEMENTAL APPEAL BRIEF

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This Request for Reinstatement of the Appeal and Amended Supplemental Appeal Brief in support thereof is filed in response to the Examiner's Final Rejection, based on new grounds of rejection, mailed July 28, 2005, and the notice of non-compliance Appeal Brief mailed December 13, 2005.

CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that this correspondence is being facsimile transmitted to the United States Patent and Trademark Office on January 4, 2006.

Janice B. Davis
Janice B. Davis

The fees required under Sections 1.17(b) and 1.17(c) are believed to have been paid pursuant to the appeal brief filed January 28, 2004. No fees are believed due at this time, however, if the office determines that a credit is due, or an additional fee is necessary than they are authorized to charge deposit account 08-2447.

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I. REAL PARTY IN INTEREST

The real party in interest is Celgard Inc., the assignee of record in the instant application.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences. Applicants note that this is the same case that was the subject of Appeal No. 2004-2240 which was remanded to the Examiner.

III. STATUS OF THE CLAIMS

Claims 1, 16, and 19 are rejected under 35 U.S.C. 102(b) as being anticipated by JP 11-169676.

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of U.S. Patent No. 5,186,832 ("Mancusi").

Claims 17-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of U.S. Patent No. 4,961,760 ("Caskey").

Claims 4-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of U.S. Patent No. 4,800,019 ("Bikson").

Claims 21, 24 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of Applicant's Admitted Prior Art.

Claims 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of in view of Applicant's Admitted Prior Art in further view of Bikson.

Claims 25 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of in view of Applicant's Admitted Prior Art in further view of Caskey.

Claims 1-2, 4-5, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mancusi in view of Bikson.

Claims 1-2, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mancusi in view of JP 11,169676.

Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mancusi in view of JP 11,169676 and in further view of Bikson.

Claims 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mancusi in view of Bikson in further view of Caskey.

Claims 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mancusi in view of JP 11,169676 and in further view of Caskey.

Claims 21 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mancusi in view of JP 11,169676 and in further view of Applicant's Admitted Prior Art.

Claims 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mancusi in view of JP 11,169676 and in further view of Applicant's Prior Art and Bikson.

Claims 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mancusi in view of JP 11,169676 and in further view of Applicant's Prior Art and Caskey.

Claims 1-2, 4-5, 16, and 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,284,584 ("Huang") in view of Mancusi and in further view of Bikson.

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Huang in view of Mancusi and in further view of Bikson and Caskey.

Claims 21-24 and 26-27 rejected under 35 U.S.C. 103(a) as being unpatentable over Huang in view of Mancusi and in further view of Bikson and Applicant's Admitted Prior Art.

Claims 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Huang in view of Mancusi and in further view of Bikson, Applicant's Admitted Prior Art, and Caskey.

Claims 1-2, 4-5, 16-19, and 21-27 are the subject of this appeal. Claims 3, 20, and 28 are canceled. Claims 6-15 are withdrawn from consideration in view of a restriction requirement.

IV. STATUS OF AMENDMENTS

No Amendment was made after the final rejection based on the new grounds for rejection.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The following is a concise explanation of the subject matter defined in independent Claims 1 and 21.

The instant invention, according to Claim 1, is a method of making a hollow fiber membrane contactor. (Specification, Page 4, Lines 12-13). The method of making a hollow fiber membrane contactor, according to Claim 1, includes the following steps: (1) winding a hollow fiber fabric around a center tube; (2) first potting the fabric and the tube together; (3) forming thereby a unitized structure; (4) placing the structure into a shell; (5) second mold potting the structure into a space between the structure and the shell; and (6) forming thereby a cartridge. (Specification; Page 7, line 16 to Page 18, Line 25).

The instant invention, according to Claim 21, is a method of making a hollow fiber membrane contactor. (Specification, Page 4, Lines 12-13). The method of making a hollow fiber membrane contactor, according to Claim 21, includes the following steps: (1) winding a hollow fiber fabric around a center tube to a diameter of at least six inches; (2) bead potting the fabric and the tube together; (3) forming thereby a unitized structure; (4) placing the structure into a shell; (5) mold potting the structure and the shell together by injecting a potting material into a space between the structure and the shell; and (6) forming thereby a cartridge. (Specification; Page 7, line 16 to Page 8, Line 25; and Page 9, lines 8-11).

VI. GROUND'S OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 16, and 19 are rejected under 35 U.S.C. 102(b).

Claims 1-2, 4-5, 16-19, and 21-27 are rejected under 35 U.S.C. 103(a).

Claims 1-2, 4-5, 16-19, and 21-27 are the subject of this appeal.

VII. ARGUMENT

Claims 1, 16, and 19 are not anticipated by JP 11-169676 under 35 U.S.C. 102(b).

Claims 1-2, 4-5, 16-19, and 21-27, for the reasons explained hereinbelow, are non-obvious under 35 U.S.C. 103(a); thus, the above-mentioned 103 rejections are improper, and they must be removed.

The Applicant incorporates herein by reference all of the argument submitted previously in support of the instant appeal, in addition to the arguments provided hereinbelow in support of the instant appeal.

A. CLAIMS 1, 16, AND 19 ARE NOT ANTICIPATED UNDER 102(b).

Claims 1, 16, and 19 are not anticipated by JP 11-169676 under 35 U.S.C. 102(b).

To anticipate a claim, a single source must contain all of the elements of the claim. *Hybritech Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1379, 231 U.S.P.Q. 81, 90 (Fed. Cir. 1986). Missing elements may not be supplied by the knowledge of one skilled in the art or the disclosure of another reference. *Structural Rubber Prods. Co. v. Park Rubber Co.*, 749 F.2d 707, 716, 223 U.S.P.Q. 1264, 1271 (Fed. Cir. 1984).

The Examiner has failed to show that the JP 11-169676 discloses each and every element of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that JP 11-169676 discloses two potting steps. However, the Examiner fails to show such disclosure. The Examiner states that "regarding Claim 1, JP 11-169676 teaches the claimed process of making a hollow fiber membrane separation device (contactor) including, wrapping a hollow fiber onto a core (winding), potting the fabric and the core together to form an assembly (first potting), placing the assembly in the housing (shell), providing molds (14, 15), positioning the ends of plurality of hollow fiber bundles into the molds and

injecting a resinous material (thermosetting or thermoplastic material) into the mold to form an integrated structure with the housing (cartridge). (See Paragraph [0026])." (Examiner's Response to Reply Brief, Page 3). However, Paragraph 26 of JP 11-169676 discloses the following:

"An example of the method for manufacturing the hollow fiber membrane module in the present invention is described below. The hollow fiber membrane module has the hollow fiber membrane boundless arranged in a valleys of partition member 7 and port dispersing member 12; the aggregate of the hollow fiber membrane bundles which has a sheet-like form is rolled to form the hollow fiber membrane bundle group 13. At this time, because the port dispersing member 12 form the inlet area of the concentration port in the resin-fixed end, the manufacturing process can be simplified by sealing part of the space, separated by the wavy sheet and the flat sheet, with resin in advance. The resin at this time is not particularly restricted if it is the same as the resin fixing the ends of the hollow fiber membrane. The rolled hollow fiber membrane bundle aggregate 13 is inserted in the container 1, the mold 14, 15 are installed on both ends, and **both ends of the hollow fiber membrane bundle group are permeated with resin using centrifugal adhesion method, pot bonding method, or the like, bonded and fixed at the same time.** After the resin is cured, the molds are removed and the surplus parts are cut off. At this time, a partitioned space, divided by wavy sheet and flat sheet of the port dispersing member 12 in the resin end on the closed end side of hollow fiber membranes, forms a plurality of through holes in the resin end."

Nowhere, in the Paragraph 26, JP 11-169676 discloses two step potting. There is no two potting steps because **both ends of the hollow fiber membrane bundle group are permeated with resin**, which means that no tube sheet has formed yet. The Examiner has failed to show that JP 11-169676 discloses two potting steps as required by the instant invention. Therefore, JP 11-169676 does not disclose

each and every element of the instant invention, i.e. two potting steps; accordingly, claims 1, 16, and 19 are not anticipated by JP 11-169676.

B. CLAIM 2 IS NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claim 2 is non-obvious over JP 11,169676 in view of U.S. Patent No. 5,186,832 ("Mancusi") under 35 U.S.C. 103(a).

To reject claims in an application under section 103, an examiner must show a *prima facie* case of obviousness. *In re Deuel*, 51 F. 3d 1552, 1557, 34 U.S.P.Q.2D 1210, 1214 (Fed. Cir. 1995). All words in a claim must be considered in judging the patentability of that claim against prior art. *In re Wilson*, 424 F.2d 1382, 1385, 165 U.S.P.Q. 494, 496 (CCPA 1970). To establish a *prima facie* case of obviousness, the following three basic elements must be met: (1) there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; (2) the prior art reference or references when combined must teach or suggest all the claim limitations; and (3) there must be a reasonable expectation of success. MPEP § 2143. In addition, if an independent claim is non-obvious under 35 U.S.C. 103, then any claim depending therefrom

is non-obvious. *In re Fine*, 837 F. 2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988).

Claim 2 is non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claim 2 is non-obvious.

C. CLAIMS 17-18 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 17-18 are non-obvious over JP 11,169676 in view of U.S. Patent No. 4,961,760 ("Caskey") under 35 U.S.C. 103(a).

Claims 17-18 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion

that JP 11,169676 discloses two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step.

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 17-18 are non-obvious.

D. CLAIMS 4-5 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 4-5 are non-obvious over JP 11,169676 in view of U.S. Patent No. 4,800,019 ("Bikson") under 35 U.S.C. 103(a).

Claims 4-5 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that JP 11,169676 discloses two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step.

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 4-5 are non-obvious.

E. CLAIMS 21, 24, AND 27 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 21, 24, and 27 are non-obvious over JP 11,169676 in view of Applicant's Admitted Prior Art under 35 U.S.C. 103(a).

Claims 21, 24, and 27 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that JP 11,169676 discloses two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step.

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 21, 24, and 27 are non-obvious.

F. CLAIMS 22 AND 23 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 22 and 23 are non-obvious over JP 11,169676 in view of in view of Applicant's Admitted Prior Art in further view of Bikson under 35 U.S.C. 103(a).

Claims 22 and 23 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention,

i.e. two potting steps. Examiner's argument is based on the notion that JP 11,169676 discloses two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step.

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 22 and 23 are non-obvious.

G. CLAIMS 25 AND 26 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 25 and 26 are non-obvious over JP 11,169676 in view of in view of Applicant's Admitted Prior Art in further view of Caskey under 35 U.S.C. 103(a).

Claims 25 and 26 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that JP 11,169676 discloses two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step.

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against

the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 25 and 26 are non-obvious.

H. CLAIMS 1-2, 1-5, AND 19 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 1-2, 4-5, and 19 are non-obvious over Mancusi in view of Bikson under 35 U.S.C. 103(a).

Claims 1-2, 4-5, and 19 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie case of obviousness*.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that Mancusi discloses two potting steps. However, as explained throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 1-2, 4-5, and 19 are non-obvious.

I. CLAIMS 1-2, AND 19 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 1-2, and 19 are non-obvious over Mancusi in view of JP 11,169676 under 35 U.S.C. 103(a).

Claims 1-2, and 19 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 10, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against

the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 1-2, and 19 are non-obvious.

J. CLAIMS 4-5 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 4-5 are non-obvious over Mancusi in view of JP 11,169676 and in further view of Bikson under 35 U.S.C. 103(a).

Claims 4-5 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's

Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 4-5 are non-obvious.

K. CLAIMS 16-18 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 16-18 are non-obvious over Mancusi in view of Bikson in further view of Caskey under 35 U.S.C. 103(a).

Claims 16-18 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that Mancusi discloses two potting steps. However, as explained throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation

to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 16-18 are non-obvious.

I. CLAIMS 16-18 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 16-18 are non-obvious over Mancusi in view of JP 11,169676 and in further view of Caskey under 35 U.S.C. 103(a).

Claims 16-18 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's

Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 16-18 are non-obvious.

M. CLAIMS 21 AND 27 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 21 and 27 are non-obvious over Mancusi in view of JP 11,169676 and in further view of Applicant's Admitted Prior Art under 35 U.S.C. 103(a).

Claims 21 and 27 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the

required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 21 and 27 are non-obvious.

N. CLAIMS 22 AND 23 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 22 and 23 are non-obvious over Mancusi in view of JP 11,169676 and in further view of Applicant's Prior Art and Bikson under 35 U.S.C. 103(a).

Claims 22 and 23 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the

instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 22 and 23 are non-obvious.

O. CLAIMS 24-26 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 24-26 are non-obvious over Mancusi in view of JP 11,169676 and in further view of Applicant's Prior Art and Caskey under 35 U.S.C. 103(a).

Claims 24-26 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 24-26 are non-obvious.

P. CLAIMS 1-2, 4-5, 16, AND 18-19 ARE NON-OBVIOUS UNDER 35 U.S.C.

103(a)

Claims 1-2, 4-5, 16, and 18-19 are non-obvious over U.S. Patent No. 5,284,584 ("Huang") in view of Mancusi and in further view of Bikson under 35 U.S.C. 103(a).

Claims 1-2, 4-5, 16, and 18-19 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application

discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 1-2, 4-5, 16, and 18-19 are non-obvious.

Q. CLAIM 17 IS NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 17 is non-obvious over Huang in view of Mancusi and in further view of Bikson and Caskey under 35 U.S.C. 103(a).

Claims 17 is non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claim 17 is non-obvious.

R. CLAIMS 21-24, AND 26-27 ARE NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 21-24 and 26-27 are non-obvious over Huang in view of Mancusi and in further view of Bikson and Applicant's Admitted Prior Art under 35 U.S.C. 103(a).

Claims 21-24 and 26-27 are non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the

required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claims 21-24 and 26-27 are non-obvious.

S. CLAIM 25 IS NON-OBVIOUS UNDER 35 U.S.C. 103(a)

Claims 25 is non-obvious over Huang in view of Mancusi and in further view of Bikson, Applicant's Admitted Prior Art, and Caskey under 35 U.S.C. 103(a).

Claims 25 is non-obvious because the Examiner has failed to show all of the required elements to establish a *prima facie* case of obviousness.

The Examiner has failed to show that the combined teachings of the prior art references cited against the instant Application discloses all of the required features of the instant invention, i.e. two potting steps. Examiner's argument is based on the notion that either JP 11,169676 or Mancusi disclose two potting steps. However, as explained above, JP 11,169676 fails to disclose two potting step. Furthermore, throughout the prosecution of the

instant Application, the Applicant has shown that Mancusi does not teach two potting step. (See Applicant's Reply Brief to Examiner's Supplemental Answer, Dated May 18, 2005, Page 5, Line 11 to Page 10, line 2).

Therefore, the Examiner has failed to show that the combined teachings of the prior art references cited against instant Application discloses all of them required features of the instant invention, i.e. two potting steps.

Additionally, it is a burden upon the Examiner to show a suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps. The Examiner, however, fails to show any suggestion or motivation to modify the teachings of the prior art references cited against the instant Application to achieve the required features of the instant invention, i.e. two potting steps.

Accordingly, Claim 25 is non-obvious.

T. CONCLUSION

In view of the foregoing, Applicant respectfully requests an early Notice of Allowance in this application.

Respectfully submitted,



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VIII Claims Appendix

1. (Previously Presented) A method of making a hollow fiber membrane contactor comprising the steps of:

winding a hollow fiber fabric around a center tube,
first potting the fabric and the tube together,
forming thereby a unitized structure,
placing the structure into a shell,
second mold potting the structure and the shell together
by injecting a potting material into a space between the structure
and the shell, and
forming thereby a cartridge.

2. (Original) The method of claim 1 wherein the first-mentioned potting being bead potting.

3. (Cancelled) ~~The method of claim 1 wherein the second-mentioned potting being mold potting.~~

4. (Original) The method of claim 1 further comprising the step of heat-treating the cartridge.

5. (Original) The method of claim 4 wherein the heat-treating further comprises a first heat-treating and a second heat-treating.

6. (Withdrawn) A hollow fiber membrane contactor comprising:
a unitized structure comprising
a center tube,
a hollow fiber fabric wound around said tube, and
a first potting material joining together said fabric and said tube;
a shell; and
a second potting material joining together said structure and said shell.

7. (Withdrawn) The contactor of claim 6 wherein said structure having a diameter of six (6) inches or more.

8. (Withdrawn) The contactor of claim 6 further comprising end caps located at end portions of said shell.

9. (Withdrawn) The contactor of claim 6 wherein the first potting material and the second potting material are the same.

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10. (Withdrawn) The contactor of claim 6 wherein the potting material is selected from the group consisting of thermosetting materials and thermoplastic materials.

11. (Withdrawn) The contactor of claim 10 wherein the thermosetting materials are selected from the group consisting of epoxy and polyurethane.

12. (Withdrawn) The contactor of claim 10 wherein the thermoplastic materials are selected from the group consisting of polyolefins and polyurethanes.

13. (Withdrawn) The contactor of claim 5 further comprising fabric spacer, said spacer adapted for maintaining said fiber of said fabric in a uniform and spaced apart fashion.

14. (Withdrawn) A system of contactors for degassing a liquid comprising at least two contactors coupled together, one said contactor being the contactor of claim 6.

15. (Withdrawn) The system of claim 14 wherein said structure having a diameter of 6 inches or greater.

16. (Previously Presented) The method of claim 1 wherein potting further comprises the first or the second potting with a material selected from the group consisting of thermosetting materials and thermoplastic materials.

17. (Previously Presented) The method of claim 16 wherein the thermosetting material being selected from the group consisting of epoxy and polyurethane.

18. (Previously Presented) The method of claim 16 wherein the thermoplastic material being selected from the group consisting of polyolefins and polyurethanes.

19. (Previously Presented) The method of claim 1 wherein placing the structure into a shell further comprises centering the structure in the shell.

20. (Canceled) The method of claim 1 wherein ~~potting the structure and the shell together further comprises injecting a potting material into a space between the structure and the shell.~~

21. (Previously Presented) A method of making a hollow fiber membrane contactor comprising the steps of:

winding a hollow fiber fabric around a center tube to a diameter of at least six inches,

bead potting the fabric and the tube together,

forming thereby a unitized structure,

placing the structure into a shell,

mold potting the structure and the shell together by injecting a potting material into a space between the structure and the shell, and

forming thereby a cartridge.

22. (Previously Presented) The method of claim 21 further comprising the step of heat-treating the cartridge.

23. (Previously Presented) The method of claim 22 wherein the heat-treating further comprises a first heat-treating and a second heat-treating.

24. (Previously Presented) The method of claim 21 wherein bead or mold potting further comprises using a material selected from the group consisting of thermosetting materials and thermoplastic materials.

25. (Previously Presented) The method of claim 24 wherein the thermosetting material being selected from the group consisting of epoxy and polyurethane.

26. (Previously Presented) The method of claim 24 wherein the thermoplastic material being selected from the group consisting of polyolefins and polyurethanes.

27. (Previously Presented) The method of claim 21 wherein placing the structure into a shell further comprises centering the structure in the shell.

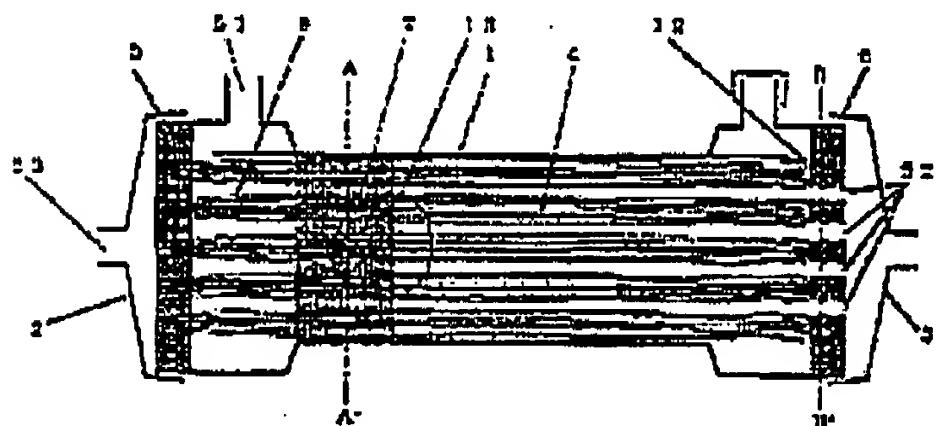
(54) [Title of the Invention]

Hollow fiber membrane module and a manufacturing method thereof

(57) [Abstract]

[Object] To provide a hollow fiber membrane module and a method of manufacture thereof, [such that the hollow fiber membrane module has] superior stability over long-term continuous operation and can be cleaned, and a structure wherein a uniform axial flow is produced without channelling, and without filling the container with the hollow fiber membrane at a high filling rate, for water treatment requiring a high rate of recovery.

[Means for Resolving] A hollow fiber membrane module having a structure wherein a hollow fiber membrane bundle group, near the port communicating with the outer surface of the hollow fiber membrane established on the side of the container in one module container, comprises a space communicating with the outside of the cross section perpendicular to the axis and the center of the hollow fiber membrane bundle group; and in which there are partitions for dividing the channel in the cross-sectional direction perpendicular to the axis of the hollow fiber membrane bundles; and in which a plurality of divisions is provided to a port communicating with the outer surface of the hollow fiber membrane disposed on the resin-fixed end of the hollow fiber membrane.



[Claims]

[Claim 1] A hollow fiber membrane module wherein a hollow fiber membrane bundle group is installed in a container, one or both ends are fixed with resin, and [the module] comprising at least one port A communicating with the inlet of the hollow fiber membrane, at least one port B communicating with the outer surface of the hollow fiber membrane disposed on the side of the container, and at least one port C communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane; wherein [the] hollow fiber membrane module comprises a partition forming a plurality of divisions in the channel in the hollow fiber membrane in a cross-sectional direction perpendicular to the axis of the hollow fiber membrane bundle group, and wherein the hollow fiber membrane bundle group installed in the container in the vicinity of at least one port B has a plurality of divisions, and space is distributed between the divided hollow fiber membrane bundles.

[Claim 2] The hollow fiber membrane module, recited in Claim 1, wherein the port C communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane has a plurality of divisions and is disposed regularly.

[Claim 3] The hollow fiber membrane module, recited in Claim 1 or 2, wherein the filling rate of the hollow fiber membrane is 40% to 80%.

[Claim 4] The hollow fiber membrane module, recited in any of Claims 1 to 3, having a structure wherein the length of the hollow fiber membrane which is not bonded and fixed is at least 1.01 times the length of the distance between the bonded parts of both ends and can oscillate.

[Claim 5] The hollow fiber membrane module, recited in Claim 1, wherein the arrangement of the hollow fiber membrane bundles is in the form of a spiral in the cross-sectional direction of the hollow fiber membrane bundle group.

[Claim 6] The hollow fiber membrane module, recited in Claim 2, wherein the plurality of ports C, communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane, is arranged in a spiral.

[Claim 7] A method for manufacturing a hollow fiber membrane module wherein a hollow fiber membrane bundle group is installed in a container, one or both ends are fixed with resin, and [the module] comprising at least one port A communicating with the inlet of the hollow fiber membrane, at least one port B communicating with the outer surface of the hollow fiber membrane disposed on the side of the container, and at least one port C communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane;

wherein the method for manufacturing the hollow fiber membrane module comprises:
bundling hollow fiber membranes to form hollow fiber membrane bundles;
arranging and rolling into a cylinder the hollow fiber membrane bundles on a partition
member for distributing the flow channels and a port distributing member for forming a plurality of
ports in the resin-fixed end of the hollow fiber membrane, to form a hollow fiber membrane bundle
group;

distributing space between the divided hollow fiber membrane bundles by fixing the ends of
the hollow fiber membrane bundle group with resin and cutting the fixed ends;
forming regularly distributed axial channels; and
forming a plurality of regularly distributed ports C on one of the fixed ends and forming a
hollow fiber membrane open end on the other end.

[Claim 8] The method for manufacturing a hollow fiber membrane module, recited in Claim
7, wherein the arrangement of the hollow fiber membrane bundles is in the form of a spiral in the
cross-sectional direction of the hollow fiber membrane bundle group.

[Claim 9] The method for manufacturing a hollow fiber membrane module, recited in Claim
7, wherein the plurality of ports C, communicating with the outer surface of the hollow fiber
membrane established on the resin-fixed end of the hollow fiber membrane, is arranged in a spiral.

[Detailed Description of the Invention]

[0001]

[Technical field of the Invention]

The present invention relates to a hollow fiber membrane module and a manufacturing
method thereof used in water purification treatment of natural water such as river water, ground
water, or the like, or in advanced water purification treatment for tap water. The hollow fiber
membrane module attained with the present invention can be used in the field of water treatment,
which requires long-term continuous operation at high rates of recovery and the restoration of
module performance by physical cleaning or the like.

[0002]

[Prior Art]

Recently, in the field of water purification treatment of natural water such as river water,
ground water, or the like, purification methods applying membrane separation technology have
become noteworthy as methods for replacing coagulation-sedimentation. Modules using hollow fiber

membranes are widely employed for water purification because [such modules] can be installed in containers, regardless of the form of the container, and can be physically cleaned with ease.

[0003]

Modules employed in water purification must have a module design with a high rate of recovery (rate of recovery = discharge ratio of permeate to feed water) in order for maximal recovery of feed water and for effective utilization. Also, in order for operation at a high rate of recovery, the upstream side of the membrane in the module is highly concentrated; moreover, in the case of a reverse osmosis membrane or nano-filtration membrane, the flow rate at the upstream side of the membrane in the module is very low and the linear velocity on the membrane surface becomes very low. Generally, in this situation, uniform distribution of the feed, without causing channeling and across the entire hollow fiber membrane surface, is difficult in the case of an external pressure-type module. When channeling occurs in the module, the membrane cannot be used effectively and the separation efficiency drops markedly. Also, when a highly concentrated liquid flows at very low speeds to the upstream side of the membrane in the module, foulant adheres and settles on the membrane's surface, the membrane surface contributing to separation becomes coated and deteriorates, and the separation capacity drops markedly. For this reason, a module design which eliminates both channeling and fouling is necessary for water purification treatment requiring a high rate of recovery.

[0004]

However, for conventional modules, a module design is used in which the hollow fiber membrane is given a uniform distribution and a uniformly distributed flow is developed within the module, by bundling the hollow fiber membrane at an extremely high filling rate in order to suppress channeling. Also used is a module design in which uniformly distributed flow is caused by creating a resistive element by fixing one end of [the hollow fiber membrane] to the container with resin and forming the other end of the hollow fiber membrane in a loop.

[0005]

In JP-S52-49987, JP-S52-63179, JP-S54-5796, and JP-S63-1404 are disclosed hollow fiber membrane modules having a module structure which is provided an axial flow, in which the hollow fiber membrane is rolled in a crisscross arrangement to form hollow fiber membrane bundles in order to suppress channeling, a tube is established in the hollow fiber membrane bundle, and flow to the central portion in a cross sectional direction of the hollow fiber membrane bundle is generated.

[0006]

Also, in JP-S61-103503 and JP-H9-206563 are disclosed hollow fiber membrane modules wherein a plurality of hollow fiber membrane bundles are arranged within the container to form a hollow fiber membrane bundle group, with both ends fixed with resin.

[0007]

Also, in JP-H9-187628 and JP-H9-220446 are disclosed hollow fiber membrane modules, wherein through holes are formed in the resin end portions fixing the hollow fiber membrane bundles, in order to supply raw water to the central portion in a cross-sectional direction perpendicular to the hollow fiber membrane bundles. Also, in JP-H9-187628 and JP-H9-220446 are disclosed module manufacturing methods, as methods for manufacturing through holes in the resin end portions wherein a tube-shaped item or through hole mold is installed in advance and removed following the bonding of the ends of the hollow fiber bundles.

[0008]

[Problems to be Solved by the Invention]

However, in a module in which the hollow fiber membrane is bundled at an extremely high filling rate, the hollow fiber membrane is easily damaged when the hollow fiber membrane bundles are inserted in the container and it becomes very difficult to manufacture the modules. Also, because of the low [amount of] space, the radial resistance to flow in the cross section of the hollow fiber membrane bundles becomes very high as module size increases and the treated water does not have a uniform radial distribution. As a result, channeling is promoted, the membrane is not effectively used, and separation efficiency becomes poor. Furthermore, in water purification requiring a high rate of recovery, the surface of the hollow fiber membrane as well as the gaps in the hollow fiber membrane are easily fouled because the upstream side of the membrane is highly concentrated, the transmission rate decreases, and long-term continuous operation becomes difficult. Also, in the case of physical cleaning of the foulant, the high filling rate of the hollow fiber membrane oppositely becomes a hindrance to cleaning and reduces cleaning efficiency.

[0009]

In a module in which a uniformly distributed flow is caused by creating a resistive element by fixing one end of [the hollow fiber membrane] to the container with resin and forming the other end of the hollow fiber membrane in a loop, fouling occurs easily because of the concentrate which is highly concentrated at the looped part of the hollow fiber membrane end. Furthermore, in the case

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of physically cleaning the foulant, the form of the hollow fiber membrane bundle, ~~the hollow fiber membrane bundle~~, is